



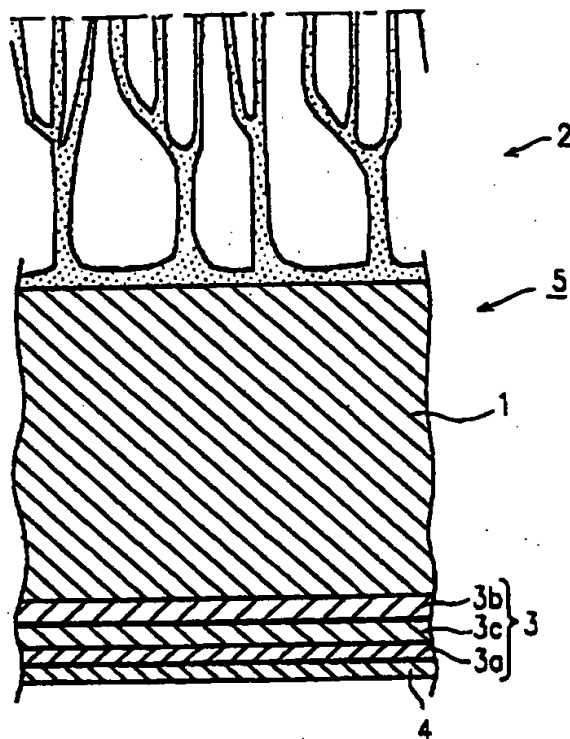
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(54) Title: A WAFER RETAINER FOR RETAINING A WAFER TO BE POLISHED AND A METHOD FOR ATTACHING/DETACHING THE WAFER RETAINER TO/FROM A BASE PLATE OF A POLISHING MACHINE

(57) Abstract

A wafer retainer for retaining a wafer to be polished according to the present invention includes: a foam layer (2) capable of adsorbing a wafer on a surface of the foam layer (2) in a detachable manner; a pressure-sensitive adhesive layer (3) for attaching the foam layer (2) to a base plate (7) of a polishing machine; and a release sheet (4) attached to the pressure-sensitive adhesive layer (3) in a releasable manner, wherein the pressure-sensitive adhesive layer (3) includes an adhesive composition containing a polymer, the polymer having a first-order melt transition in a temperature range narrower than 15 °C. Thus, the present invention provides a wafer retainer and a method for attaching/detaching the wafer retainer to/from a base plate of a polishing machine such that the wafer retainer can be peeled off the base plate by simply cooling the base plate (7) and the adhesive layer (3) of the wafer retainer, thereby facilitating the exchanging or replacement of the wafer retainer occurring after each polishing process.



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DESCRIPTION

A WAFER RETAINER FOR RETAINING A WAFER TO BE POLISHED
AND

5 A METHOD FOR ATTACHING/DETACHING THE WAFER RETAINER
TO/FROM A BASE PLATE OF A POLISHING MACHINE

TECHNICAL FIELD

10 The present invention relates to a retainer used
for retaining a workpiece to be polished, such as a
semiconductor wafer, when the workpiece is placed on a
base plate of a polishing machine for polishing, and a
method for attaching/detaching the retainer to/from the
15 base plate of the polishing machine.

BACKGROUND ART

20 In recent years in the semiconductor industry,
the integration level of ICs has rapidly increased. It
has increased from 4M to 16M and is now proceeding to the
64M level.

25 In light of the above circumstances, demand for
a wafer having a higher-quality surface from which ICs
are formed has increased. In order to increase the
integration level of ICs, aside from improvement on the
chemical and electrical properties of the wafer, reduc-
tion of the minimum width allocated for devices to be
30 formed on the wafer is increasingly demanded. Now, 0.35
microns is requested, as compared to 0.5 microns in the
past.

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In order to achieve such high-precision processing, the flatness of the surface of the wafer, i.e., the uniformity and precision of the thickness of the wafer is requested to be more strict. Specifically, the total thickness variation for a wafer after final mirror-finishing and polishing needs to be 1 micron or less, while the local thickness variation (LTV) over a 20 mm square, which is to be one IC chip, needs to be 0.2 micron or less.

10

In order to satisfy these precision requirements during the wafer polishing process, the wafer must be mounted on a base plate of a polishing machine precisely in parallel with the plane of the base plate. In general, the following two methods are conventionally employed for mounting the wafer on the base plate of the polishing machine.

15

One of the methods includes applying molten wax to a heated base plate. The wafer is secured to the base plate via the wax.

20

According to this method, the wafer secured to the base plate is polished. After polishing, the base plate is heated again to melt the wax, detaching the wafer from the base plate. The wafer is then cleaned with an organic solvent to remove wax attachments from the wafer.

25

This method is advantageous in that variations in the thickness of the polished wafer are small. However, the steps of heating and cooling the base plate are required before and after each polishing. This undesirably

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necessitates a heating step of heating and melting wax and the use of a harmful organic solvent for cleaning the wafer to remove wax attachments.

5 The other method uses a wafer retainer which is to be described in the present invention. A retainer is adhered to a base plate in advance, and a wafer is adsorbed to the surface of the retainer via liquid such as water. According to this method, the wafer can be
10 easily mounted on and detached from the base plate during the polishing process, thereby improving the efficiency and facilitating automatization. The wafer retainer is generally secured to the base plate with a pressure-sensitive adhesive (PSA) with high tack strength.

15 This method, however, is disadvantageous in that the adhesive layer formed on the back surface of the wafer retainer is so firmly adhered to the base plate that a tack strength as large as about 2 to 3 kg/inch
20 width is exhibited when the wafer retainer is intended to be detached from the base plate in a general manner. Specifically, a force of 57 kg at maximum is required to detach the wafer retainer from a polishing machine base plate with a diameter of 485 mm. Thus, it takes an
25 extraordinarily large amount of labor to exchange the used wafer retainer with a new one.

 Thus, the objectives of the present invention are
30 (1) to provide a wafer retainer for retaining a wafer to be polished which adheres to a base plate of a polishing machine firmly and stably when the wafer is polished and is easily peeled off the base plate when intended to be detached, (2) to provide a method for attaching/detaching

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the wafer retainer to/from the base plate of the polishing machine, (3) to provide a wafer retainer for retaining a wafer to be polished which, when being exchanged or replaced, can be easily peeled off a base plate of a polishing machine by simply cooling the base plate and an adhesive layer of the wafer retainer, and (4) to provide a method for attaching/detaching the wafer retainer to/from the base plate of the polishing machine.

10 DISCLOSURE OF THE INVENTION

A wafer retainer for retaining a wafer to be polished according to the present invention includes: a foam layer capable of adsorbing a wafer on a surface of the foam layer in a detachable manner; a pressure-sensitive adhesive layer for attaching the foam layer to a base plate of a polishing machine; and a release sheet attached to the pressure-sensitive adhesive layer in a releasable manner, wherein the pressure-sensitive adhesive layer includes an adhesive composition containing a polymer, the polymer having a first-order melt transition occurring in a temperature range narrower than 15°C.

In one embodiment of the invention, the adhesive composition includes a side-chain crystallizable polymer as the polymer in an amount such that the pressure-sensitive adhesive layer becomes substantially untacky to the base plate of the polishing machine at 20°C or less and substantially tacky to the base plate of the polishing machine at a temperature higher than 20°C.

In another embodiment of the invention, the side-chain crystallizable polymer includes as a main component

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thereof an acrylic acid ester and/or methacryl acid ester which has a straight-chain alkyl group including 10 or more carbons as a side chain.

5 In still another embodiment of the invention, the side-chain crystallizable polymer is a copolymer of (meth)acrylate having 10 to 14 carbons and at least one monomer selected from the group consisting of acrylic acid and (meth)acrylate having 1 to 4 carbons.

10

In still another embodiment of the invention, the copolymer includes the following components: 40% to 95% by weight of (meth)acrylate having 10 to 14 carbons; 1% to 10% by weight of acrylic acid; and/or 5% to 40% by weight of (meth)acrylate having 1 to 4 carbons.

15

A method for attaching/detaching the wafer retainer according to the present invention to/from a base plate of a polishing machine includes the steps of:

20 attaching the wafer retainer to the base plate of the polishing machine by removing the release sheet of the wafer retainer from the pressure-sensitive adhesive layer, and thereafter allowing the pressure-sensitive adhesive layer of the wafer retainer to adhere to the

25 base plate of the polishing machine while keeping the base plate at a temperature T1; and after use of the wafer retainer, detaching the wafer retainer from the base plate of the polishing machine while cooling the base plate from the temperature T1 to a temperature T2, the temperature T2 being lower than the temperature T1.

30

In one embodiment of the invention, the temperature T1 is 20°C or above, and the temperature T2 is below

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20°C.

5 In another embodiment of the invention, the temperature T1 is 25°C or above, and the temperature T2 is below 20°C.

BRIEF DESCRIPTION OF THE DRAWINGS

10 Figure 1 is a sectional view of a wafer retainer according to the present invention.

15 Figure 2A is a sectional view showing the status where a foam layer is formed on a substrate, forming a backing film. Figure 2B is a sectional view showing an adhesive film.

20 Figure 3 is a sectional view showing the status where the surface area of the foam layer of the backing film shown in Figure 2A has been buffed.

Figure 4 is a sectional view showing the status where a template is placed on the top surface of the backing film shown in Figure 3.

25 Figure 5 is a sectional view showing the status where the wafer retainer of the present invention has been adhered to a base plate.

BEST MODE FOR CARRYING OUT THE INVENTION

30

The wafer retainer for retaining wafers to be polished according to the present invention includes at least: a foam layer capable of adsorbing a wafer on a

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5 surface of the foam layer in a detachable manner; a pressure-sensitive adhesive layer for attaching the foam layer to a base plate of a polishing machine; and a release sheet attached to the pressure-sensitive adhesive layer in a releasable manner. The wafer retainer may be composed of three layers as described above, or may include an additional layer. For example, a sheet substrate may be additionally formed between the foam layer and the adhesive layer to obtain a 4-layered wafer
10 retainer.

As the sheet substrate, a sheet made of a synthetic resin such as polyethylene terephthalate, polyetherimide, and polyurethane may be used. For
15 example, a polyester film (Lumirror, manufactured by Toray Industries, Inc.) may be used.

The foam layer is formed, for example, by applying to the sheet substrate a foam composition including
20 urethane polymer, vinyl polymer such as vinyl chloride polymer, vinyl chloride-vinyl acetate copolymer, and vinyl chloride-vinyl acetate-vinyl alcohol ternary polymer, and a suitable foam solvent such as dimethylformaldehyde and solidifying the foam composition
25 by a wet solidification method. The surface area of the foam layer, especially a skin layer formed on the surface, is preferably buffed to allow a wafer to be adsorbed thereon easily.

30 The adhesive layer is formed on the back surface of the foam layer or on the back surface (the surface facing the base plate of the polishing machine) of the substrate when the wafer retainer includes the substrate.

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The adhesive layer is made of an adhesive composition which contains a polymer having a first-order melt transition occurring in a range narrower than about 15°C. The adhesive composition is a polymer composition having
5 a first melt transition somewhere between about 5°C and 50°C. This transition occurs preferably in a range narrower than about 15°C, more preferably in a range narrower than about 10°C.

10 The first-order melt transition of the polymer can be measured by a viscoelasticity meter.

As disclosed in Japanese National Patent Publication No. 4-507425, the adhesive composition contains a
15 sufficient amount of a side-chain crystallizable polymer so that the resultant adhesive layer can be substantially non-tacky to the base plate of the polishing machine at a temperature of about 20°C or less and substantially tacky to the base plate at a temperature more than about
20 20°C.

The temperature T1 of the wafer retainer during the polishing of the wafer is preferably 20°C or more, more preferably in the range of about 25 to about 35°C,
25 most preferably in the range of about 25 to about 30°C. The temperature T2 of the wafer retainer at the detachment of the wafer retainer from the base plate is preferably less than 20°C, more preferably in the range of about 10 to about 20°C.

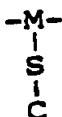
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As the side-chain crystallizable polymer, side-chain crystallizable and/or main-chain crystallizable polymers are preferred. These polymers include polymers

which exhibit the temperature-dependent adhesion properties. Crystallizable polymers which may be used in the adhesive composition may include both side-chain crystallizable and main-chain crystallizable polymers. The side-chain crystallizable polymers contain crystallizable side-chain moieties, while the main-chain crystallizable polymers are rendered crystallizable by their backbone structure. Examples of such polymers include those selected from the group consisting of single stereoregular polyolefin alkylacrylate, and alkylmethacrylate.

The side-chain crystallizable polymer used in the present invention can be formulated so as to contain a mixture of two or more different polymers.

In general, these polymers contain monomer units X of the formula:



wherein M is a bivalent group capable of forming a main chain of a polymer (or a backbone atom), S is a spacer unit, and C is a crystallizable group. These polymers generally have a heat of fusion (ΔH_f) of at least about 20 Joules/g, preferably at least about 40 Joules/g.

The polymers contain about 50 to about 100 wt.% monomer units represented by "X". If the polymer contains less than 100% X, it additionally contains monomer units which may be represented by "Y" or "Z", or both,

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wherein Y is any polar or nonpolar monomer or mixture of polar or nonpolar monomers capable of polymerizing with X or Z, and Z is a mixture of polar or nonpolar monomers.

5 Examples of the polar monomers include polyoxyalkylenes, acrylates including hydroxyethylacrylate, acrylamides, and methacrylamide. These monomers increase adhesion to most substrates.

10 The backbone of the polymer (defined by "M") may be any organic structure (aliphatic or aromatic hydrocarbon, ester, ether, amide, etc.) or an inorganic structure (sulfide, phosphazine, silicone, etc.), and may include
15 spacer linkages which can be any suitable organic or inorganic unit, for example, ester, amide, hydrocarbon, phenyl, ether, or ionic salt (e.g., a carboxyl-alkyl ammonium or sulphonium or phosphonium ion pair or other known ionic salt pair).

20 The side-chain (defined by "S" and "C") may be aliphatic or aromatic or a combination of aliphatic and aromatic, but must be capable of entering into a crystalline state. Common examples are: linear aliphatic side-chains of at least 10 carbon atoms, e.g., C_{10} - C_{22} acrylates
25 or methacrylates, acrylamides or methacrylamides, vinyl ethers or esters, siloxanes or alpha olefins; fluorinated aliphatic side-chains of at least 6 carbon atoms; and p-alkyl styrene side-chains wherein the alkyl group contains 8 to 24 carbon atoms.

30

 The length of the side-chain moiety is usually greater than 5 times the distance between side-chains in the case of acrylates, methacrylates, vinyl esters,

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acrylamides, methacrylamides, vinyl ethers, and α -olefins.

5 The side-chain units should make up greater than 50% of the volume of the polymer, preferably greater than 65% of the volume.

10 In addition to one or more type of the above-described polymers, the adhesive composition may contain conventional additives such as a tackifier (e.g., rosin, polyester), an antioxidant, a fibrous or non-fibrous filler, and a colorant. An additional adhesive may also be contained in the adhesive composition unless it significantly affects the overall temperature-sensitive
15 property of the adhesion composition. The amount of the crystallizable polymer contained in the adhesive composition is preferably in the range of about 40% by weight to about 100% by weight.

20 Especially suitable examples of the polymer contained in the adhesive composition are as follows:

25 (1) the copolymer of 90-97 parts by weight of tetradecyl acrylate and 3-10 parts by weight of acrylic acid

30 (2) the copolymer of 10-60 parts by weight of lauryl acrylate, 40-90 parts by weight of tetradecyl acrylate, and 3-10 parts by weight of acrylic acid

 (3) the copolymer of 70-90 parts by weight of tetradecyl acrylate, 5-20 parts by weight of butyl acrylate, and 3-10 parts by weight of acrylic acid

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(4) the copolymer of 70-90 parts by weight of hexadecyl acrylate, 5-20 parts by weight of butyl acrylate, and 3-10 parts by weight of acrylic acid

5 The suitable temperatures at use of the adhesive compositions including the above copolymers (1) to (4) are as follows:

10 (1) about 20°C. The temperature at which the adhesiveness greatly lowers is about 15°C or less.

15 (2) about 10 to about 20°C. The temperature at which the adhesiveness greatly lowers is about 5°C or less when about 10°C is used and about 15°C or less when about 20°C is used.

20 (3) about 0 to about 15°C. The temperature at which the adhesiveness greatly lowers is about -5°C or less when about 0°C is used and about 10°C or less when about 15°C is used.

25 (4) about 15 to about 35°C. The temperature at which the adhesiveness greatly lowers is about 10°C or less when about 15°C is used and about 30°C or less when about 35°C is used.

30 Especially suitable is a copolymer of (meth)acrylate having 10-14 carbons, acrylic acid, and/or (meth)acrylate having 1-4 carbons, of which temperature sensitivity and tackiness are well balanced. Such a copolymer contains 40% by weight or more, preferably 45 to 95% by weight of (meth)acrylate having 10-14 carbons, 1 to 10% by weight, preferably 2 to 5% by weight of

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acrylic acid, and/or 5 to 40% by weight, preferably 10 to 35% by weight of (meth)acrylate.

5 The adhesive composition containing the polymer
exhibiting the above-described temperature-dependent
adhesion properties may be directly applied to the foam
layer or the sheet substrate to form the adhesive layer
with a uniform thickness. Alternatively, the adhesive
composition may be thinly and uniformly applied to a thin
10 sheet substrate, and then the resultant substrate with
the adhesive layer may be laminated with the foam layer
or the sheet substrate with the foam layer formed there-
on.

15 The adhesive composition may be applied as it is
or as an emulsion or a latex with an appropriate solvent.
Appropriate monomers which can form a polymer and addi-
tives may be directly applied to the foam layer or th
sheet substrate and cured by heating, radiation, or any
20 other appropriate method known to those skilled in the
art.

 A release sheet (or a release film) is attached
to the exposed surface of the adhesive layer, so that the
25 adhesive layer is protected by the release sheet until
the wafer retainer is actually used. The release sheet
is composed of a soft thin film, for example, a paper
sheet, a plastic film such as a polypropylene film, and
a metal foil, which is surface-treated with a release
30 agent, if necessary, to facilitate the releasing. In
particular, a silicone-treated polyester film is pre-
ferred in the aspect of dusting characteristics and
smoothness.

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5 The wafer retainer with the above structure is attached to the base plate of the polishing machine typically in the following manner. First, the base plate is removed from the polishing machine, cleaned, and secured horizontally so that the surface thereof to which the wafer retainer is to be attached is exposed at room temperature (generally, about 25°C). The wafer retainer is taken out from a package and, after removing the release sheet from the tacky surface of the wafer retain-
10 er, placed on the base plate so that the tacky surface comes into contact with the exposed surface of the base plate. At this time, the wafer retainer is desirably curved lightly before being attached to the base plate, so that the center portion of the retainer can attach to the base plate first, followed by gradual attachment toward the periphery of the retainer. Pressure is then applied to the entire top surface of the wafer retainer from above uniformly by any appropriate method. The pressure is preferably 1 kg/cm² or less. As an example
20 of pressure application, the wafer retainer may be pressed with a flat plane via a sufficiently thick elastic member. Most preferably, the retainer may be covered with a plastic sheet. Air under the plastic sheet is absorbed to obtain negative pressure and thus
25 pressurize the wafer retainer.

Through the above process, the adhesive layer on the back surface of the substrate of the wafer retainer closely adheres to the base plate. The tack strength of the wafer retainer attached to the base plate at this
30 time is as strong as about 2 to 3 kg/inch width, which is exhibited when the former is intended to be detached from the latter in a general manner.

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After the attachment of the wafer retainer to the polishing machine in the above manner and subsequent processing of the wafer, the wafer retainer is detached from the base plate in the following manner. The tacki-
5 ness of the temperature-activated pressure-sensitive adhesive formed on the back surface of the wafer retainer rapidly decreases by cooling the base plate by about 5°C below room temperature, i.e., to about 20°C. The tack strength lowers to about 0.2 to 0.5 kg/inch width,
10 allowing the wafer retainer from detaching from the base plate easily. The base plate may be cooled by immersing it in water or cold water, showering it with water or cold water, or exposing it to cold air blow.

15 Thus, in the wafer retainer according to the present invention, the adhesive composition constituting the adhesive layer includes a polymer having a first-order melt transition occurring in a range narrower than 15°C. With such an adhesive composition including a
20 temperature-activated pressure-sensitive adhesive, the tackiness of the adhesive layer to the base plate can be greatly lowered by cooling the base plate and the wafer retainer. Thus, the wafer retainer can be easily detached from the base plate at the time of the exchange of
25 the used wafer retainer with a new one.

The first-order melt transition refers to a phenomenon occurring at a temperature in about the middle between the glass transition point and the melting point,
30 observed when the viscoelasticity of a polymer is measured by gradually increasing the temperature. By slightly varying the temperature from an arbitrarily set temperature (for example, 2 to 5°C), the polymer becomes

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crystalline or non-crystalline reversibly, resulting in an aggressive change in the tackiness of the polymer to the base plate as described above.

5 Hereinafter, the present invention will be specifically described by way of examples. However, the invention is not limited to the examples.

(Example 1)

10 As shown in Figure 2A, Composition I (having the composition shown in Table 1) was coated at a thickness of 700 microns on a polyester film 1 (Lumirror, manufactured by Toray Industries, Inc.; thickness: 188 microns). Composition I was then allowed to wet-coagulate so as to
15 form a foam layer 2. This composite was subjected to a washing process and a drying process, whereby a backing film was obtained. The outermost 100 microns (indicated as 2a in Figure 2A) of the resultant backing film was eliminated by buffing, whereby a backing film shown in
20 Figure 3 was obtained.

 A temperature-activated pressure-sensitive adhesive (manufactured by Landeck Corporation) was coated at a thickness of 20 microns on one face of a polyester
25 film 3c (Lumirror, manufactured by Toray Industries, Inc.; thickness: 25 microns), thereby forming an adhesive layer 3a. On the other face of this polyester film, a conventional adhesive composition (AR-798: an acrylic adhesive manufactured by Sankyo Chemical Co., Ltd.) was
30 coated so as to have a thickness of 20 microns, thereby forming an adhesive layer 3b. Then, each adhesive layer was covered with a release sheet 4. Thus, a double coated adhesive film A with release sheets 4 was obtained

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as shown in Figure 2B.

5 The release sheet 4 on the adhesive layer 3b of the above adhesive film A was peeled, and thus the adhesive layer 3b of the above adhesive film A was attached to the polyester film 1 of the backing film, thereby producing a backing film 5 (shown in Figure 1) with a temperature-activated pressure-sensitive adhesive provided thereon. In Figure 1, reference numeral 3 (including 3a, 3b, and 3c) denotes an adhesive layer, and 10 4 denotes a release sheet.

15 The backing film 5 was cut into a circle having a diameter of 485 mm. A template 6 (composed of glass epoxy resin) with recesses for positioning and retaining wafers was attached to the backing film 5 by means of a press. Thus, a template with a backing film was obtained (Figure 4).

20 The template 6 having the doubled coated adhesive tape thereon had an outer diameter of 485 mm and seven 6-inch pockets (recesses). The template 6 includes an adhesive layer provided on one face thereof, with a release sheet being attached to the adhesive layer. The 25 release sheet was peeled off the adhesive layer, and the template 6 was attached onto the backing film 5. Thus, a wafer retainer was completed.

30 Next, as shown in Figure 5, the release sheet 4 of the wafer retainer was peeled off the wafer retainer, and the wafer retainer was lightly attached to a ceramic upper base plate 7 of a polishing machine. Thereafter, a flat composed of quartz (weight: 10 kg; outer diameter:

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485 mm) was uniformly placed on the template 6 and was left for 30 minutes so as to allow the adhesive to gain intimacy with the upper base plate 7. The adhesion temperature was at 25°C.

5

The above-described wafer retainer was evaluated by using a single-side polishing machine (SPM-19, manufactured by Fujikoshi Kikai). Wafers of silicon monocrystal P (100) (diameter: 6 inches) were subjected to a polishing under the conditions described in Table 2. Fifty polishes, each requiring 30 minutes, were continuously performed. After the wafer retainer was thus used, the ceramic upper base plate with the non-usable wafer retainer was immersed in pure water at 20°C. The wafer retainer having the temperature-activated pressure-sensitive adhesive easily peeled off the upper base plate at a peeling force of at most 7 kg.

10

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(Example 2)

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25

A temperature-activated pressure-sensitive adhesive was directly coated at a thickness of 20 microns, thereby forming an adhesive layer 3, on a back face (i.e., on a polyester film 1 side) of a backing film which was fabricated by the same manner described in Example 1. A release sheet 4 was attached to this adhesive layer 3 so as to fabricate a backing film 5 having the structure shown in Figure 1.

30

A template (composed of a glass epoxy resin sheet) having a diameter of 485 mm and seven 6-inch pockets (recesses) was attached to a ceramic upper base plate by using the same double coated adhesive film A employed in Example 1. Specifically, the adhesive

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layer 3a of the double coated adhesive film A was attached to the ceramic upper base plate. The adhesion was conducted at 25°C for 2 minutes, with a load of 1.5 kg/cm² applied to the template. Furthermore, the above-mentioned backing film was cut into circles having a diameter of 6 inches. After the release sheet 4 was peeled, each circular-shaped backing film was inserted into a pocket (recess) of the template. Thus, the backing films were secured to the ceramic upper base plate, whereby a wafer retainer was obtained.

The above-described wafer retainer was evaluated by using a single-side polishing machine (SPM-19, manufactured by Fujikoshi Kikai). Wafers of silicon monocrystal P (100) (diameter: 6 inches) were subjected to a polishing under the conditions described in Table 2. Fifty polishes, each requiring 30 minutes, were continuously performed. After the wafer retainer was thus used, the ceramic upper base plate with the non-usable wafer retainer was immersed in pure water at 20°C. Each backing film having the temperature-activated pressure-sensitive adhesive easily peeled off the upper base plate at a peeling force of at most 2.4 kg. The template also easily peeled off the upper base plate at a peeling force of at most 2.8 kg.

(Comparative Example 1)

Composition I was coated at a thickness of 700 microns on a polyester film 1 (Lumirror, manufactured by Toray Industries, Inc.; thickness: 188 microns). Composition I was then allowed to wet-coagulate. This composite was subjected to a washing process and a drying process, whereby a backing film having the structure

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shown in Figure 2 was obtained. The outermost 100 microns of (indicated as 2a in Figure 2) of the backing film was eliminated by buffing, whereby a backing film shown in Figure 3 was obtained.

5

A commercially available double coated adhesive tape (ST-442, manufactured by Sumitomo 3M Corporation) was attached to the polyester film 1 of the above-mentioned backing film, thereby producing a backing film with a conventional pressure-sensitive adhesive.

10

This backing film was cut into a circle having a diameter of 485 mm. As in Example 1, a template 6 (composed of glass epoxy resin) with recesses for positioning and retaining wafers was attached to the backing film 5 by means of a press. Thus, a template with a backing film was obtained (Figure 4).

15

The template 6 having the doubled coated adhesive tape had an outer diameter of 485 mm and seven 6-inch pockets (recesses). As described above, the template 6 includes an adhesive layer provided on one face thereof, a release sheet being attached to the adhesive layer. Thus, a wafer retainer was completed.

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Next, as shown in Figure 5, the release sheet of the wafer retainer was peeled off, and the wafer retainer was lightly attached to a ceramic upper base plate of a polishing machine. Thereafter, a flat composed of quartz (weight: 10 kg; outer diameter: 485 mm) was uniformly placed on the template 6 and was left for 30 minutes so as to allow the adhesive to gain intimacy with the upper base plate 7. The adhesion temperature was at 25°C.

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The above-described wafer retainer was evaluated by using a single-side polishing machine (SPM-19, manufactured by Fujikoshi Kikai). Wafers of silicon monocrystal P (100) (diameter: 6 inches) were subjected to a polishing under the conditions described in Table 2. Fifty polishes, each requiring 30 minutes, were continuously performed. After the wafer retainer was thus used, the non-usable wafer retainer was peeled off the ceramic upper base plate, requiring a peeling force of at most 34 kg. As will be appreciated, the template of the wafer retainer of Comparative Example 1 could not be peeled off as easily as the templates of the wafer retainers of Examples 1 and 2.

Table 1

Ester-type polyurethane (CRISVON-7667; manufactured by Dainippon Ink and Chemicals, Inc.)	100 phr
dimethylformamide (manufactured by Nitto Chemical Industry Co., Ltd.)	50 phr
Pigment (DILAC-5442; manufactured by Dainippon Ink and Chemicals, Inc.)	20 phr
Surfactant (K ASSISTOR SD-7; manufactured by Dainippon Ink and Chemicals, Inc.)	3 phr

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Table 2

Polishing machine	Single-side polishing machine (SPM-19; manufactured by Fujikoshi Kikai) with a carrier plate (diameter: 485 mm)
Wafer to be processed	Silicon monocrystal P (100) wafer (diameter: 6 inches)
Polishing cloth	SUBA800
Polishing slurry	NALCO2350; diluted by 20 times
Processing pressure	300 g/cm ²
Slurry flow rate	500 ml/min.
Processing time	30 min.

(Example 3)

(Hereinafter, "parts" represent "parts by weight".)

20 A. Preparation of a polymer

Forty-five parts of tetradecylacrylate, 50 parts of dodecylacrylate, 5 parts of acrylic acid, and 0.3 parts of azobis isobutyronitrile (AIBN) were mixed in 200 parts of toluene, and stirred at 60°C for 20 hours to allow these monomers to polymerize. The resultant polymer had a molecular weight of 500,000 and a melting point of 10°C.

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A polymer solution was prepared by using a solvent (heptane:ethyl acetate = 90 parts:10 parts) so that the solid portion in the polymer solution accounted for 30% by weight. A temperature-activated pressure-sensitive adhesive was obtained by adding 0.1 parts of a cross-linking agent (Kemitalto PZ-33) to 100 parts of this polymer solution.

10 B. Fabrication of a wafer retainer and an evaluation thereof

15 A double coated adhesive film B with release sheets provided thereon was obtained in the same manner the double coated adhesive film A in Example 1 was produced except that the above-mentioned temperature-activated pressure-sensitive adhesive was used in the place of the temperature-activated pressure-sensitive adhesive (manufactured by Landeck Corporation) of the double coated adhesive film A.

20 A wafer retainer was obtained in the same manner the wafer retainer of Example 1 was obtained except for using the double coated adhesive film B having release sheets. The resultant wafer retainer was evaluated in 25 the same manner as in Example 1 except that the ceramic upper base plate with the wafer retainer was immersed in pure water at about 0°C.

30 The wafer retainer having the temperature-activated pressure-sensitive adhesive easily peeled off an upper base plate at a peeling force of at most 6 kg.

(Exempl 4)

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A. Preparation of a polymer

Ninety-five parts of tetradecylacrylate, 5 parts of acrylic acid, and 0.3 parts of azobis isobutyronitrile (AIBN) were mixed in 200 parts of toluene, and stirred at 60°C for 20 hours to allow these monomers to polymerize. The resultant polymer had a molecular weight of 500,000 and a melting point of 21°C.

A polymer solution was prepared by using a solvent (heptane:ethyl acetate - 90 parts:10 parts) so that the solid portion in the polymer solution accounted for 30% by weight. A temperature-activated pressure-sensitive adhesive was obtained by adding 0.1 parts of a cross-linking agent (Kemitaito PZ-33) to 100 parts of this polymer solution.

B. Fabrication of a wafer retainer and an evaluation thereof

A double coated adhesive film C with release sheets provided thereon was obtained in the same manner the double coated adhesive film A in Example 1 was produced except that the above-mentioned temperature-activated pressure-sensitive adhesive was used in the place of the temperature-activated pressure-sensitive adhesive (manufactured by Landeck Corporation) of the double coated adhesive film A.

A wafer retainer was obtained in the same manner the wafer retainer of Example 1 was obtained except for using the above-mentioned double coated adhesive film C having release sheets. The resultant wafer retainer was evaluated in the same manner as in Example 1 except that

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the ceramic upper base plate with the wafer retainer was immersed in pure water at about 10°C.

5 The wafer retainer having the temperature-activated pressure-sensitive adhesive easily peeled off an upper base plate at a peeling force of at most 5 kg.

(Example 5)

10 A. Preparation of a polymer

Fifty parts of hexadecylacrylate, 45 parts of dodecylacrylate, 5 parts of acrylic acid, and 0.3 parts of azobis isobutyronitrile (AIBN) were mixed in 200 parts of toluene, and stirred at 60°C for 20 hours to allow
15 these monomers to polymerize. The resultant polymer had a molecular weight of 500,000 and a melting point of 20°C.

A polymer solution was prepared by using a
20 solvent (heptane:ethyl acetate = 90 parts:10 parts) so that the solid portion in the polymer solution accounted for 30% by weight. A temperature-activated pressure-sensitive adhesive was obtained by adding 0.1 parts of a cross-linking agent (Kemitaito PZ-33) to 100 parts of
25 this polymer solution.

B. Fabrication of a wafer retainer and an evaluation thereof

30 A double coated adhesive film D with release sheets provided thereon was obtained in the same manner the double coated adhesive film A in Example 1 was produced except that the above-mentioned temperatur -

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activated pressure-sensitive adhesive was used in the place of the temperature-activated pressure-sensitive adhesive (manufactured by Landeck Corporation) of the double coated adhesive film A.

5

A wafer retainer was obtained in the same manner the wafer retainer of Example 1 was obtained except for using the above-mentioned double coated adhesive film D having release sheets. The resultant wafer retainer was evaluated in the same manner as in Example 1 except that the ceramic upper base plate with the wafer retainer was immersed in pure water at about 10°C.

The wafer retainer having the temperature-activated pressure-sensitive adhesive easily peeled off an upper base plate at a peeling force of at most 4 kg.

(Example 6)

20 A. Preparation of a polymer

Seventy-five parts of hexadecylacrylate, 20 parts of butylacrylate, 5 parts of acrylic acid, and 0.3 parts of azobis isobutyronitrile (AIBN) were mixed in 200 parts of toluene, and stirred at 60°C for 20 hours to allow these monomers to polymerize. The resultant polymer had a molecular weight of 400,000 and a melting point of 20°C.

A polymer solution was prepared by using a solvent (heptane:ethyl acetate = 90 parts:10 parts) so that the solid portion in the polymer solution accounted for 30% by weight. A temperature-activated pressure-sensitive adhesive was obtained by adding 0.1 parts of a

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cross-linking agent (Kemitaito PZ-33) to 100 parts of this polymer solution.

5 B. Fabrication of a wafer retainer and an evaluation thereof

10 A double coated adhesive film E with release sheets provided thereon was obtained in the same manner the double coated adhesive film A in Example 1 was produced except that the above-mentioned temperature-activated pressure-sensitive adhesive was used in the place of the temperature-activated pressure-sensitive adhesive (manufactured by Landeck Corporation) of the double coated adhesive film A.

15

A wafer retainer was obtained in the same manner the wafer retainer of Example 1 was obtained except for using the above-mentioned double coated adhesive film E having release sheets. The resultant wafer retainer was evaluated in the same manner as in Example 1 except that the ceramic upper base plate with the wafer retainer was immersed in pure water at about 10°C.

20

25 The wafer retainer having the temperature-activated pressure-sensitive adhesive easily peeled off an upper base plate at a peeling force of at most 7 kg.

(Comparative Example 2)

30

An adhesive composed of 100 parts of butylacrylate, 5 parts of acrylonitrile, and 5 parts of acrylic acid was prepared.

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5 A double coated adhesive film with release sheets provided thereon was obtained in the same manner the double coated adhesive film A in Example 1 was produced except that the above-mentioned temperature-activated pressure-sensitive adhesive was used in the place of the temperature-activated pressure-sensitive adhesive (manufactured by Landeck Corporation) of the double coated adhesive film A.

10 A wafer retainer was obtained in the same manner the wafer retainer of Example 1 was obtained except for using the above-mentioned double coated adhesive film having release sheets. The resultant wafer retainer was evaluated in the same manner as in Example 1.

15 The wafer retainer having the temperature-activated pressure-sensitive adhesive easily peeled off an upper base plate at a peeling force of at most 28 kg.

20 The exchanging or replacement of a wafer retainer for retaining wafers to be polished according to the present invention, conducted after each polishing process, is substantially facilitated because the wafer retainer can be peeled off a base plate by simply cooling
25 the base plate and an adhesive layer of the wafer retainer.

CLAIMS

1. A wafer retainer for retaining a wafer to be polished, the wafer retainer comprising:
- 5 a foam layer capable of adsorbing a wafer on a surface of the foam layer in a detachable manner;
- a pressure-sensitive adhesive layer for attaching the foam layer to a base plate of a polishing machine; and
- a release sheet attached to the pressure-sensitive adhesive layer in a releasable manner,
- 10 wherein the pressure-sensitive adhesive layer comprises an adhesive composition containing a polymer, the polymer having a first-order melt transition occurring in a temperature range narrower than 15°C.
- 15 2. A wafer retainer according to claim 1, wherein the adhesive composition comprises a side-chain crystallizable polymer as the polymer in an amount such that the pressure-sensitive adhesive layer becomes
- 20 substantially untacky to the base plate of the polishing machine at 20°C or less and substantially tacky to the base plate of the polishing machine at a temperature higher than 20°C.
- 25 3. A wafer retainer according to claim 2, wherein the side-chain crystallizable polymer comprises as a main component thereof an acrylic acid ester and/or methacryl acid ester which has a straight-chain alkyl group including 10 or more carbons as a side chain.
- 30 4. A wafer retainer according to claim 2, wherein the side-chain crystallizable polymer is a copolymer of (meth)acrylate having 10 to 14 carbons and at least one

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monomer selected from the group consisting of acrylic acid and (meth)acrylate having 1 to 4 carbons.

5 5. A wafer retainer according to claim 4, wherein the copolymer comprises the following components:

40% to 95% by weight of (meth)acrylate having 10 to 14 carbons;

1% to 10% by weight of acrylic acid; and/or

10 5% to 40% by weight of (meth)acrylate having 1 to 4 carbons.

6. A method for attaching/detaching the wafer retainer according to claim 1 to/from a base plate of a polishing machine, the method comprising the steps of:

15 attaching the wafer retainer to the base plate of the polishing machine by removing the release sheet of the wafer retainer from the pressure-sensitive adhesive layer, and thereafter allowing the pressure-sensitive adhesive layer of the wafer retainer to adhere to the
20 base plate of the polishing machine while keeping the base plate at a temperature T1; and

after use of the wafer retainer, detaching the wafer retainer from the base plate of the polishing machine while cooling the base plate from the temperature T1 to
25 a temperature T2, the temperature T2 being lower than the temperature T1.

7. A method according to claim 6, wherein the temperature T1 is 20°C or above, and the temperature T2 is below
30 20°C.

8. A method according to claim 6, wherein the temperature T1 is 25°C or above, and the temperature T2 is below

20°C.

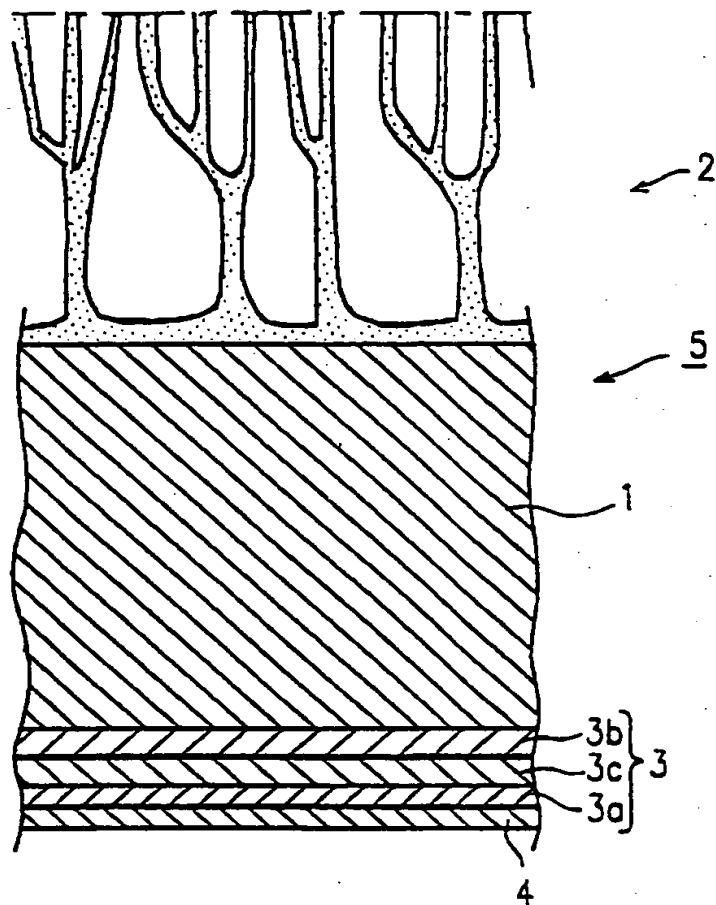
FIG. 1

FIG. 2A

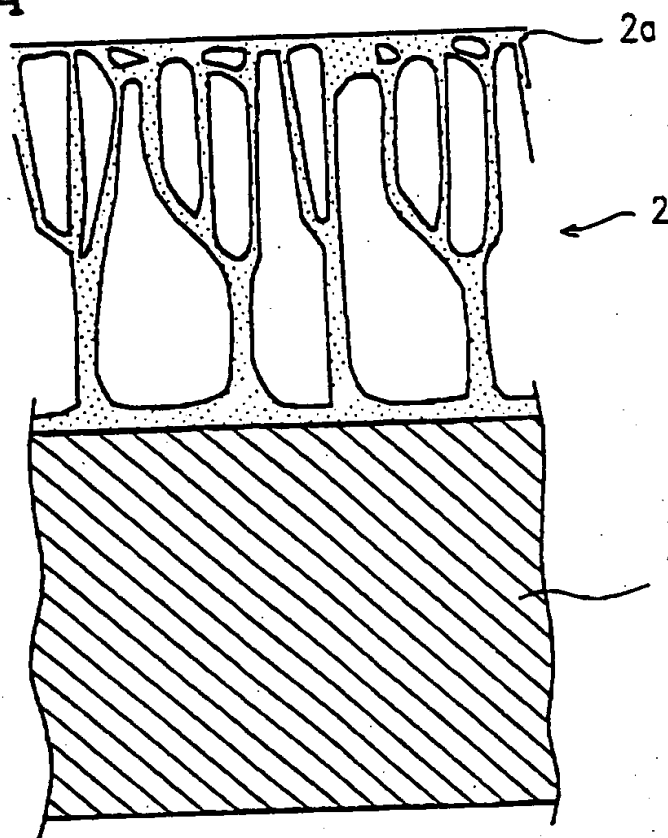


FIG. 2B

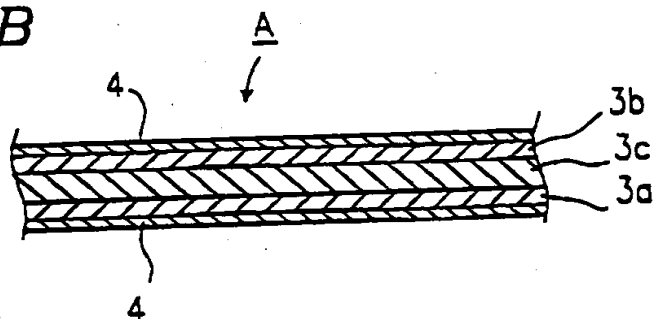


FIG. 3

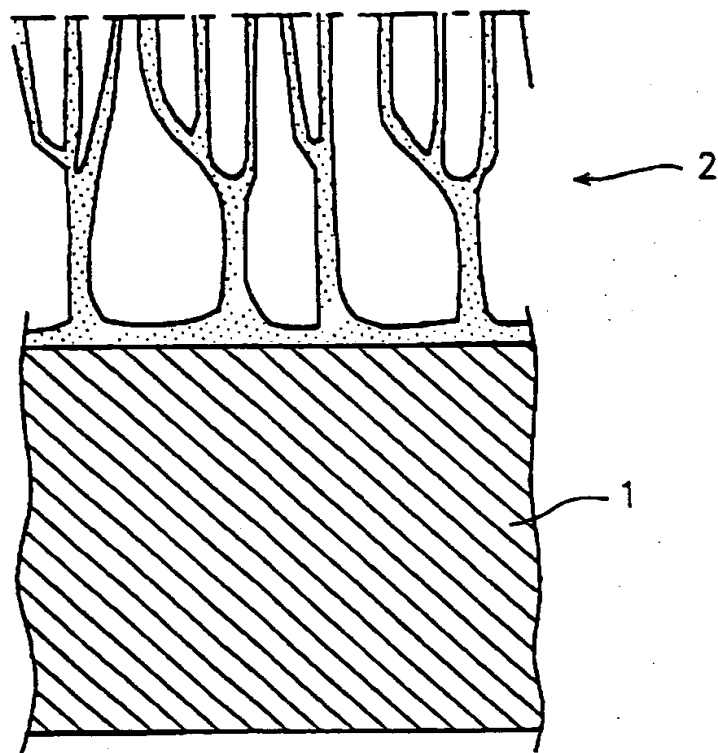


FIG. 4

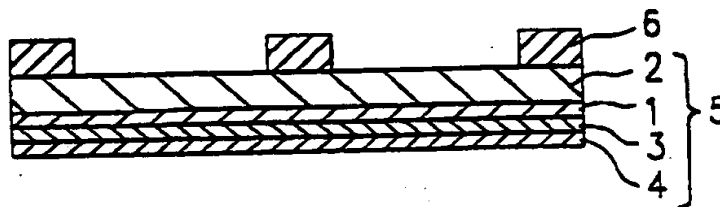
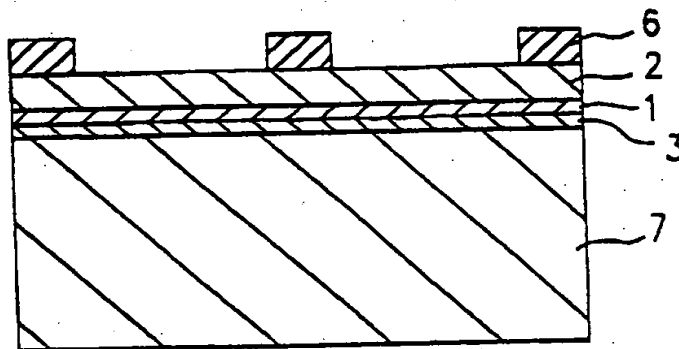


FIG. 5



INTERNATIONAL SEARCH REPORT

Int. Appl. No.

PCT/JP 96/00806

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B24B37/04 C09J7/02 H01L21/68 H01L21/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B24B C09J H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,5 356 949 (KOMIYAMA MIKIO ET AL) 18 October 1994 see abstract ---	1,3,6
A	EP,A,0 439 258 (ASAHI DENKA KOGYO KK) 31 July 1991 see abstract ---	1,6
A	US,A,4 921 564 (MOORE ARTHUR H) 1 May 1990 see abstract; figure 5 ---	1,6
A	US,A,4 756 968 (EBE KAZUYOSHI ET AL) 12 July 1988 -----	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/JP 96/00806

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-5356949	18-10-94	JP-A- 2032181	01-02-90
		JP-B- 7015087	22-02-95
		DE-D- 68920807	09-03-95
		DE-T- 68920807	29-06-95
		EP-A- 0359373	21-03-90
		KR-B- 9509551	24-08-95
		US-A- 5118567	02-06-92
		US-A- 5110388	05-05-92

EP-A-0439258	31-07-91	JP-A- 3210312	13-09-91
		AT-T- 122088	15-05-95
		DE-D- 69109309	08-06-95
		DE-T- 69109309	28-09-95
		ES-T- 2073113	01-08-95
		US-A- 5360873	01-11-94
		US-A- 5278199	11-01-94

US-A-4921564	01-05-90	GB-A,B 2219135	29-11-89
		JP-C- 1822603	10-02-94
		JP-A- 2031441	01-02-90

US-A-4756968	12-07-88	JP-B- 1049754	25-10-89
		JP-C- 1576987	24-08-90
		JP-A- 62205179	09-09-87
		JP-C- 1608022	13-06-91
		JP-B- 2014384	06-04-90
		JP-A- 62205180	09-09-87
		JP-C- 1638457	31-01-92
		JP-B- 2058306	07-12-90
		JP-A- 63017980	25-01-88
		JP-C- 1603517	04-04-91
		JP-B- 2015594	12-04-90
		JP-A- 62153375	08-07-87
		JP-B- 1056112	28-11-89
		JP-C- 1712427	11-11-92
		JP-A- 62153376	08-07-87
		JP-C- 1608021	13-06-91
		JP-B- 2015595	12-04-90
		JP-A- 62153377	08-07-87
		DE-A- 3639266	02-07-87

INTERNATIONAL SEARCH REPORT

(information on patent family members)

International Application No.

PCT/JP 96/00806

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4756968		FR-A,B 2592390	03-07-87
		GB-A,B 2184741	01-07-87
		GB-A- 2221468	07-02-90
		GB-A- 2221469	07-02-90
		GB-A- 2221470	07-02-90
		NL-A,B,C 8603269	16-07-87
		NL-A- 9302147	05-04-94
		NL-A- 9302148	05-04-94
		NL-A- 9302149	05-04-94
		NL-A- 9302150	05-04-94
		US-A- 4965127	23-10-90
		US-A- 5187007	16-02-93
